

REMARKS

The application has been amended so as to place it in condition for allowance at the time of the next Official Action.

Claims 1-15, 17, and 19 are pending. This amendment amends certain of the originally-filed claims and cancels claims 16 and 18.

There are no formal matters outstanding.

Applicants acknowledge with appreciation that the Official Action indicated that the claims 8-10 and 17 were directed to allowable subject matter.

The Official Action rejected claims 1-7 and 11-14 under §103 as being obvious over YASUDA 2001/0045531 A1, in view of KELLEHER et al. 5,734,197, and further in view of GO 6,377,742.

The Official Action rejected claims 15, 16, and 18 under §103 as being obvious over YASUDA, in view of MIZUUCHI 6,194,238, and further in view of KELLEHER et al.

The official Action rejected claim 19 under §103 as obvious over YASUDA, in view of MIZUUCHI, and further in view of KELLEHER et al. and GO.

Applicants have carefully studied the disclosure of these references, both individually and in combination. Applicants respectfully submit that the pending obviousness rejections are not viable and outline their reasons below.

The Present Invention

The present invention has the following points (1) through (3) entirely new in the art:

(1) A photocoupler, having a structure double-sealed with light-transmitting resin and light-intercepting resin, can be provided with an LLG (Lead-frame Land Grid-array) configuration in which outside terminals are positioned inside of the sealed resin;

(2) To implement the LLG configuration, part of a lead-frame inside a package is deformed to form an outside terminal portion. At this instant, physical stress to act on the lead-frame is caused to be concentrated on the deformed portion weaker than the other portion and is therefore prevented from acting on the other portion; and

(3) To protect the weaker deformed portion from further deformation after a preselected step, a resin sealing step is used to deposit reinforcing resin.

Only the present invention includes a step to positively deform a lead-frame for implementing a packaging structure and recover a demerit ascribable to the deformation. See the method claims beginning with claim 15, as well as the structural features recited in claims 1-14.

YASUDA

Although the Yasuda reference includes a figure showing buried deformed portions, the deformed portions are

used to support a chip or to implement a reflector for a light-emitting device. Moreover, such deformed portions are not cut off or positively used to implement a device structure in which portions other than the deformed portions are further deformed.

The Rejections

As for claims 1, 5, 11 and 14 on file, the present invention is entirely different from YASUDA as to the lead frame and the procedure for forming the deformed portions. Regarding the lead frame, the present invention effects the deformation in the tie bar in order to form an outside terminal with the deformed portion and to cause the deformed portion to absorb stress ascribable to the deformation thereby preventing the outside frame from deforming. By contrast, YASUDA effects deformation in order to cut off, e.g., a chip support portion, to cut off a tie-bar functioning to obviate the burr of light-transmitting resin or to enhance the emission efficiency of a light-emitting device. The object of YASUDA therefore has nothing to do with the absorption of physical stress that acts during processing. Indeed, the Official Action acknowledged that YASUDA does not disclose the recited deformable portion within the tie bar.

For this feature the Official Action offers KELLEHER et al. Figure 1, together with GO Figure 9. An

absorbing mechanism taught by KELLEHER uses deformation for coping with "overcurrent", as is clear from "bimetallic", but does not absorb a physical force. This is why the deformed portions of KELLEHER are not partly varied in physical dimension. Claims 1 and 5 have been amended to clarify this feature of the invention.

Regarding the procedure for forming the deformed portion, although YASUDA, like the present invention, cuts off a tie-bar after the sealing with light-transmitting resin, the present invention does not cut off the deformed portion. Moreover, the present invention completes the deformation for enhancing emission efficiency during the formation of the lead-frame. Also, KELLEHER does not effect deformation during processing, but effects it when a device is in use.

The Official Action sets forth that GO teaches "positioning holes". However, these positioning holes are not the recited deformable portion and further the present invention does not concern the positioning holes themselves, but is a structure for protecting portions around the positioning holes from deformation.

As for claims 2 and 3, while stress to be reduced by KELLEHER is current stress, stress to be reduced by the present invention is stress ascribable to an extraneous physical force. This is why KELLEHER uses "bimetallic" while the present invention varies a dimension.

Claim 4 is dependent on claim 3 and will not need any comment and is not taught or suggested by the applied art.

As for claim 6, the Official Action appears to have misunderstood the recitation. Usually, a photocoupler is produced by use of two lead-frames, one positioned at the light-emitting device side and the other positioned at the photosensitive device side. The present invention and YASUDA both have such a structure. However, Fig. 10 of YASUDA shows that the lead-frames associated with the light-emitting device and photosensitive device are respectively bent upward and downward to a noticeable degree. In accordance with the present invention, only one of the lead-frames is bent, as shown in Figs. 5A through 5C. In this respect, 104 of Fig. 10 is different from claim 6.

As for claims 7 and 10, YASUDA seals a device itself, and so does the present invention. However, a "sealed portion" of the present invention does not refer to secondary seal resin 21 (device portion) of Fig. 7B, but refers to a reinforcing portion 23 of Fig. 7B. See the recitation of "said deformable portion is sealed with resin..." The reinforcing portion 23 serves to prevent the portion expected to absorb the stress ascribable to deformation during lead-forming from being further deformed during the step to follow. It is entirely new in the

photocoupler art to obviate deformation by reinforcement using resin sealing.

As for claims 12 and 13, in the structure of YASUDA, the outside terminals are positioned outside of the seal resin, so that the top of the lead-frame is flush with the bottom of the seal resin. In accordance with the present invention, the outside terminals each are partly positioned inside of the seal resin (light-intercepting resin), so that the bottom of the lead-frame and that of the seal resin (light-intercepting resin) are flush with each other. This successfully reduces the device height by the thickness of the lead-frame.

As for claims 15, 16, 18 and 19, although the present invention basically uses a double-mold structure customary with a photocoupler and using light-transmitting resin and light-intercepting resin, the present invention does not claim a double-mold structure itself. More specifically, claims 15 and 19 pertain to deformation stated in relation to claims 1, 5, 11 and 14 previously and do not appear to be obvious. Particularly, claim 15 additionally recites the reinforcement of the portions 23 of Fig. 7B, which is entirely new in the art.

In summary, the characteristic features (1) through (3) of the present invention stated earlier are not described or even suggested in the applied references.

HIRASAWA et al. S.N. 09/923,394

Accordingly, reconsideration and allowance of all the pending claims are respectfully requested.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned **"Version with markings to show changes made."**

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims were amended as follows:

--1. (amended) A lead frame comprising:

a tie bar to which an element loading portion to be loaded with a semiconductor element is connected by a lead forming portion;

an outside frame formed with positioning holes, said tie bar being connected to said outside frame; and

a deformable portion included in said tie bar for preventing said outside frame from deforming under extraneous physical stress.--

--5. (amended) A frame comprising a combination of lead frames arranged such that element loading portions to be loaded with semiconductor elements thereof are positioned one above the other, said lead frames each comprising:

a tie bar to which the element loading portions are connected by lead forming portions;

an outside frame formed with positioning holes, said tie bar being connected to said outside frame; and

a deformable portion included in said tie bar for

preventing said outside frame from deforming under physical stress.--

--12. (amended) The semiconductor device as claimed in claim 11, wherein the leads are positioned on an extension of a bottom of said seal resin so that a bottom surface of said leads and a bottom surface of said seal resin are coplanar.-